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The Cephalopoda Decapoda of the *Arcturus* Oceanographic Expedition, 1925.¹

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(Text-figures. 1-18).

[This paper is based on the collections taken on the *Arcturus* Oceanographic Expedition to the eastern Pacific in 1925. This, under the direction of William Beebe, was the seventeenth expedition of the department of Tropical Research of the New York Zoological Society. For detailed data on localities, dates, dredges, etc., refer to *Zoologica*, Vol. XXII, No. 2, pp. 33-46].

PREFACE.

This report was prepared by the late G. C. Robson in 1932 but his last illness prevented the paper from being completed. His successors, Mr. G. I. Crawford and Dr. W. J. Rees, have made a few minor corrections, prepared a list of species and a revised bibliography, but it has been deemed advisable to leave the text as written by the author.

The paper is of considerable interest as it deals with a hitherto little-known cephalopod fauna and also presents the views of an acknowledged authority on the status of many important genera of squids.

An appreciation and a full list of Robson's cephalopod researches by Dr. W. Adam of Brussels has been published in the *Proceeding of the Malacological Society of London*, Vol. 27, pp. 131-136, 1946.

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INTRODUCTION.

The decapod cephalopods collected by Dr. Beebe during the spring and early summer cruises of the *Arcturus* in 1925 were examined by Mr. J. F. W. Pearson and made the subject of a preliminary report. This was submitted as a thesis for a Degree in the University of Pittsburgh, but was never published. Mr. Pearson was unable to continue his work on the collection and in 1928 Dr. Beebe invited me to complete the study of the material. A copy of Mr. Pearson's thesis was sent to me and I have found it very useful as a preliminary survey. It contained much information concerning the gear used on the *Arcturus*, the stations at which cepha-

lopods were taken, and a general discussion on the research problems involved. Of these sections I have unfortunately not been able to make any use. As regards the systematic work Mr. Pearson evidently considered his identifications very provisional. In spite of the limited time at his disposal, however, and the difficulty he obviously experienced in getting the necessary literature, whenever he ventured on a specific diagnosis his judgment was rarely at fault.

The bulk of the collection consists of juvenile specimens with no associated adult stages, and it has proved quite impossible to determine the generic position of two or three forms. There are also a good number of fragments and badly mangled specimens of which the identification is very dubious.

As regards the juvenile stages of uncertain status, I have given here full particulars in the hope that when such stages are better known in the decapods as a whole, the relationships of these specimens may be understood from my descriptions.

The collection of Decapoda is represented by some 30 species and is therefore an unusually rich one. I have been compelled to describe five new species and a new genus. The majority of the species here described come from the waters near the Galápagos Archipelago and it would have been very interesting to compare this fauna with those of adjacent areas, e.g. the coast of Central America and Colombia and the more remote regions of the Pacific. Unfortunately the lists available for such a study are so meagre in contents that by the time the doubtful identifications have been eliminated, the basis for a reasonable comparison has disappeared. That 16% of the species here mentioned are new, may be a little surprising, but it must be remembered that the cephalopod fauna of the equatorial Pacific is very poorly known. There is another important fact to bear in mind. Many of the species of teuthoid decapods are regarded as cosmopolitan and the chief students of the group (notably Pfeffer), adopting a conservative attitude, have refrained from creating new species out of the obvious variants that turn up from time

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to time. Perhaps there is some justification for this attitude when the study of a group is in the stage when material is being amassed and before the extent of the variation is fully realized. But at present the assumed genetic homogeneousness of cosmopolitan marine species (seen in other groups as well, e.g. in Copepoda, etc.), if it is not a mere product of taxonomic conservatism, is a challenge to our curiosity. It implies not only that the natural "divides" (such as the Agulhas Divide) in the ocean and the regional changes of temperature and salinity, etc., have no modifying effect on the natural population (which in the case of planktonic forms such as *Liocranchia reinhardti* seems very surprising), but also that such mutations as do arise are readily suppressed and have no effect in producing the local modifications that we see in widely-ranging terrestrial animals. One is bound to view this alleged homogeneity with some suspicion. If it is, however, substantiated, it is a matter of considerable importance. As far as the Cephalopoda are concerned, the statistical analysis of natural populations is still very much limited by the smallness of the catches made, and there is great need for the intensive study of variation in the commoner and more widely ranging species.

My best thanks are due to Dr. Beebe for the opportunity of studying this interesting collection.

LIST OF SPECIES OBTAINED

Order Decapoda

Sub-order Teuthoidea

Family Loliginidae

Sepioteuthis occidentalis Robson
(?subsp. nov.)

Family Bathyteuthidae

Bathyteuthis abyssicola Hoyle
Bathyteuthis sp.

Family Enoploteuthidae

Abraliopsis hoylei (Pfeffer)
Abraliopsis ?*hoylei* (Pfeffer)
Abraliopsis sp.
Pyroteuthis giardi (Fisher)
Genus and species uncertain.

Family Octopodoteuthidae

Genus and species uncertain.
Octopodoteuthis nielsenii n. sp.
? *Octopodoteuthis* sp.

Family Onychoteuthidae

Onykia sp.
Onykia ?*appellofi* (Pfeffer)
Onychoteuthis ?*banksii* (Leach)
Genus and species uncertain (subfam.
Lycoteuthinae)

Family Histiototeuthidae

Stigmatoteuthis arcturi n. sp.
Histiothauma oceani n. gen., n. sp.
Genus and species uncertain.

Family Ommatostrephidae

Genus and species uncertain (subfam.
Illicinae)
Stenoteuthis pteropus (Steenstrup)
Stenoteuthis bartrami (Lesueur)

? *Stenoteuthis* spp. (*Rhyncoteuthion*
stage)

Hyaloteuthis pelagica (Bosc)
Symplectoteuthis oulaniensis
(Lesson)

Genus and species uncertain.

Family Chiroteuthidae

Chiroteuthis sp. (*Planctoteuthis*
stage)

Mastigoteuthis sp.
Mastigoteuthis sp.

Family Cranchiidae

Liocranchia reinhardti Steenstrup
Galiteuthis sp.
Taonidium pacificum n. sp.
Helicocranchia beebei n. sp.
Helicocranchia sp.

DESCRIPTIVE SECTION.

FAMILY LOLIGINIDAE.

Sepioteuthis occidentalis Robson
(? subsp. nov.).

One (♂) from Station 22; 1,000 miles south of Bermuda; (No. 3). Taken in dip-net at night (attracted by electric light). This specimen is rather immature, measuring only 60 mm. in dorsal mantle-length. Its main features resemble my *S. occidentalis* (Robson, 1926), but it tends to draw near to *S. ehrhardti* in the width of the fins (index: *occidentalis* 26, the present specimen 22, *ehrharti* 21). In its mantle-index (38), form of teeth of the tentacular and brachial suckers and shape of the first arms it agrees with *occidentalis* very well and differs from the other western Atlantic species. There is one marked difference, however, viz., the tentacle is like that neither of *occidentalis* nor of *ehrharti*, as it is only slightly longer than the mantle.

I note in this specimen the approximation to double hectocotylization observed in the type of *occidentalis* (Robson, 1926, p. 354, fig. 3). The only difference from the type in the *Arcturus* specimen is that the reduced suckers are continued over rather a wider area in the former.

Since the appearance of my paper on *S. occidentalis*, Boone (1928, p. 16) has revived the ambiguous *S. sloanei* Gray (Leach MS) for specimens obtained in tropical eastern American seas. The type of this West Indian form cannot be found. Boone's well-described form is quite different from my species in fin-proportions, sucker-dentition, etc.

FAMILY BATHYTEUTHIDAE.

Bathyteuthis Hoyle.

I agree with Naef and Grimpe in regarding Hoyle's name (Hoyle, 1885) as having priority over Verrill's *Benthoteuthis* (Verrill, 1885). Hoyle's date of publication was evidently May, 1885. Although the sheet on which Verrill's generic name appears is dated "April, 1885," there seems no escape from the conclusion that the actual publication was in or after the June of that year

(i.e. the date given by the last sheet of the part).

***Bathyteuthis abyssicola* Hoyle.**

1 specimen from Stn. 33; N.E. of Galápagos; PT-1 (No. 86); 600-0 fms.

1 specimen from Stn. 39; Galápagos Is.; PT-1 (No. 109); 500-0 fms.

1 specimen from Stn. 50; S.E. of Galápagos; T-2 (No. 146); 400-0 fms.

1 specimen from Stn. 59; S. of Cocos Id.; T-5 (No. 36); 600-0 fms.

1 specimen from Stn. 59; S. of Cocos Id.; T-5 (No. 35); 600-0 fms.

1 specimen from Stn. 59; S. of Cocos Id.; T-9 (No. 143); 500-0 fms.

1 specimen from Stn. 74; S. of Cocos Id.; T-21 (No. 119); 400-0 fms.

1 specimen from Stn 74; S. of Cocos Id.; OT-2 (No. 38); 750-0 fms.

1 specimen from Stn. 84; Galápagos Is.; PT-4 (No. 89); 400-0 fms.

1 specimen from Stn. 86; Galápagos Is.; T-9 (No. 37); surface.

Nos. 86, 36, 35, and 119 are well-preserved specimens, 22-7 mm. in mantle-length and of normal structure. Of the remaining specimens all are fragmentary or otherwise in poor condition, but I do not hesitate concerning their identity. One specimen (No. 146), which measures 5 mm. in mantle-length, has remarkably small fins. The width of the head, the eyes and the arm-circlet of this example remind one of the form described below. Pfeffer (1912, p. 327) regards all the described forms of *Bathyteuthis* as conspecific. Between the type specimen of *B. abyssicola* (S. Ocean), the original example of Verrill's *Benthoteuthis megalops* (regarded as synonymous) (N. Atlantic), Chun's specimens (Indian Ocean and 36° and 170° E.) and Hoyle's E. Pacific forms (Cape Mala), there are some important differences which are carefully analyzed by Pfeffer. As the matter stands now I have no option but to adopt the latter's treatment of these forms, though I am not entirely satisfied with it.

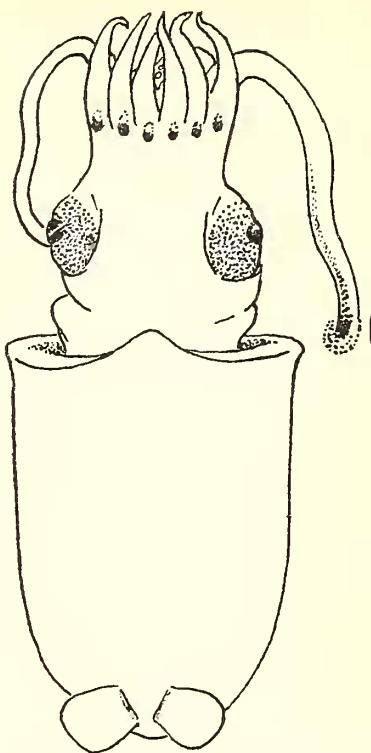
***Bathyteuthis* sp.**

(Text-figure 1).

One specimen (??) from Stn. 84, off Narborough Id., Galápagos Is. Young Fish Trawl; (No. 88); 700-0 fms.

This is represented by a small and juvenile specimen about 7 mm. long in mantle-length; it is in fairly good condition, though the body is a little distorted and the eyes somewhat damaged.

The mantle, which measures 7×5 mm., is much broader than in the equivalent stage of *B. abyssicola* ("megalops") (Chun, 1910, pl. XXIV, fig. 4). The head is narrower than at the corresponding stage of that form, in which the interocular width exceeds the mantle-width and the arm-circlet is distinctly



TEXT-FIG. 1. *Bathyteuthis* sp. from Stn. 84, (No. 88); circa×8.

narrower. One of Hoyle's Cape Mala specimens (1904, p. 33) has a broad body, the width of the latter being about two-thirds of the length. It also has a narrow arm-circlet. This specimen was 23 mm. long in mantle-length. Actually Pfeffer (1912, pl. 27, f. 13) shows a figure of a specimen from the Plankton Expedition with a narrow circlet of arms, but the shape of the body, fins and head in this specimen are very different from that seen in our Galápagos example.

The fins are diminutive, but not noticeably smaller than those of some specimens previously figured. The arms and tentacles and their suckers do not seem to differ from those of *abyssicola*. There is a very marked difference in the cephalic component of the adhesive-organ, which is very narrow in *abyssicola* (Chun, 1910, pl. XXV, fig. 7) and much wider in this form. It must be noted, however, that Chun's figure is of an adult. The tentacular manus is rather more compact than that figured by Chun.

On the whole the features agree fairly well with those of *abyssicola*. But it is impossible to treat a form so different in head- and body-shape and in general proportions as referable to that species. All the same I am unwilling to describe such a young and immature specimen as the type of new species.

Actually from Pfeffer's figures (1912, pl. 27) and Chun's it seems that there is a very great deal of variation within the forms referred to *abyssicola*. It must be noted that

undoubted *abyssicola* of approximately this size (Chun 1910, pl. XXIV, fig. 4) has the large eyes and arm-circlet of the adult.

***Abrialopsis* Joubin.**

Having had no opportunity of seeing original specimens and revising this genus, I refrain from criticizing Pfeffer's treatment (1912) in detail. It seems to me very unsatisfactory, especially as he does not state what the status of the well-figured and fully-described "*A. morisii*" of Chun (1910) is. I feel very uncertain as to the real relationships between *A. hoylei*, *A. morisii* and Hoyle's eastern Pacific "*hoylei*" (= *affinis* Pfeffer). For the time being I confine myself to describing the *Arcturus* specimens and pointing out their relationship to the various forms previously described.

***Abrialopsis hoylei* Pfeffer.**

1 specimen (?♀) from Stn. 51; S. of Galápagos Is.; T-2, (No. 154); 165-0 fms., young, 0.14 mm. long.

1 specimen (♀) from Stn. 61; W. of Cocos Id.; T-5, (No. 170); 600-0 fms., a head only.

1 specimen (♂) from Stn. 68; N. of Cocos Id.; PT. 1, (No. 24); 600-0 fms.

1 specimen (a fragment) from Stn. 68; N. of Cocos Id.; PT 1, (No. 171); 600-0 fms.

1 specimen (♀) from Stn. 74; S. of Cocos Id.; OT-4 (No. 26); 625-0 fms., discolored and without tentacles but apparently referable to this species.

1 specimen (?♀) from Stn. 74; S. of Cocos Id.; T-7 (No. 118); 450-0 fms., damaged.

2 specimens (♀) from Stn. 74; S. of Cocos Id.; (Nos. 30 & 31); 750-0 fms., a head and arm only, a good deal damaged.

The specimens as originally measured ranged from 42 mm. to 5 mm. The body in head and mantle length, and the fins in shape, tend to resemble in shape those of *hoylei* (Pfeffer, 1912, pl. 17) and differ from Chun's "*morisii*." Hoyle's fig. 3, pl. 1, is doubtless badly drawn. The ocular light-organs exactly resemble those of Chun's "*morisii*," as do the tracts on the head. The latter, but not the ocular organs, are like those figured by Hoyle (1904, pl. 10, fig. 1). The tentacular manus resembles that seen in Pfeffer's fig. 9, pl. 17, in having four neat distal rows of suckers. But it has 3 large and 3 small hooks (unlike all the others) and agrees with Chun's fig. 5, pl. VIII, in having five carpal pads and suckers. There is one sucker between the distal and middle small hooks. The structure of the hectocotylus is more or less intermediate between that seen in Hoyle's figure and that illustrated by Chun. There is no large triangular basal lappet as in Hoyle's specimens. The arrangement of the fringe on the ventral side is otherwise very like that figured by Hoyle. Hoyle figures, probably in error, the large hooks as on the ventral side, whereas in our specimen and in Chun's they are on the dorsal side. Both Hoyle and Chun

figure a number of papillae at the base of the hectocotylus; but here I most certainly found a number of small suckers.

I think this is undoubtedly a member of the polymorphic species indicated by Chun, Pfeffer and Hoyle and as such I prefer to use Pfeffer's name *hoylei* rather than that proposed by him for Hoyle's eastern Pacific specimen.

***Abrialopsis ?hoylei* Pfeffer.**

One specimen (♂) from Stn. 74; S. of Cocos Id.; (No. 23); trawl; 0-844 fms.

This is represented by a specimen 25 mm. in dorsal mantle-length. Each fin is 11.5 mm. wide by 18 mm. long (over all). They are thus well over half the mantle-length. The anterior border is convex.

The mantle is slender with some evidence of the aperture having been flared outwards. It measures 10-11 mm. at the aperture and ca. 6 mm. half way along.

The tentacular manus resembles that of Chun's "*morisii*"; but the distal rows of suckers are more numerous and the extremity is thicker and shorter.

The "Seitenbrücke" of the hectocotylized arm which are enclosed in the web are nearly five times as long as the arm is wide and the unenclosed ones are closer than in Chun's figure. Though it is damaged one would say that the hectocotylus resembles that of *hoylei* figured by Hoyle (1904, pl. 8, fig. 5).

The specimen is not very well preserved and I would not care to dogmatize about its position.

The following specimens are indeterminate:

***Abrialopsis* sp.**

1 specimen (?sex) from Stn. 51; S. of Galápagos Is.; T-3, (No. 96); 274-0 fms. A very small specimen devoid of the tentacles.

1 specimen (?♀) from Stn. 74; S. of Cocos Id.; OT2 (No. 32); 750-0 fms. Shrivelled up; unrecognizable.

***Pyroteuthis giardi* (Fischer).**

1 specimen from Stn. 38; Tower Id. Galápagos; PT. 1 (No. 70); 300-0 fms.

1 specimen from Stn. 51; S. of Galápagos Is.; T-3 (No. 99); 274-0 fms.

1 specimen from Stn. 53; S. of Galápagos Is.; T-2 (No. 100); 800-0 fms.

1 specimen from Stn. 59; S. of Cocos Id.; T-8 (No. 28); 300-0 fms.

1 specimen from Stn. 74; S. of Cocos Id.; T-56 (No. 152); surface.

1 specimen from Stn. 84; Galápagos Is.; PT-4 (No. 93); 700-0 fms.

2 specimens from Stn. 84; Galápagos Is.; T-8, 9, 10 (No. 157); 500-0 fms.

3 specimens from Stn. 84; Galápagos Is.; T-20 (No. 90); 500-0 fms.

2 specimens from Stn. 84; Galápagos Is.; T-1 (No. 149); 300-0 fms.

3 specimens from Stn. 86; Galápagos Is.; T-1 (No. 57); 400-0 fms.

3 specimens from Stn. 86; Galápagos Is.; T-2 (No. 59); 500-0 fms.

1 specimen from Stn. 86; Galápagos Is.; T-8 (No. 62); 500-0 fms.

1 specimen from Stn. 86; Galápagos Is.; T-11 (No. 69); 1,000-0 fms.

1 specimen from Stn. 86; Galápagos Is.; T-5 (No. 78); 1,000-0 fms.

2 specimens from Stn. 87; W. of Galápagos Is.; T-3 (No. 83); 450-0 fms.

The following young forms are possibly referable to this species:

from Stn. 86, Galápagos Is.; T-11 (No. 77), 1,000-0 fms.

from Stn. 86, Galápagos Is.; T-11 (No. 64), 1,000-0 fms.

from Stn. 49, off Hood Id.; T-2 (No. 107), surface.

The largest of these specimens has a mantle-head length of 30 mm. Several are in a fragmentary condition and their identity is very doubtful.

Many of these are clearly referable to *P. giardi*. There is, however, a frequent difference from the described forms in the possession of long and narrow tentacular manus. The proximal (carpal) suckers are enlarged as in the Galápagos variety (var. *hoylei* Pfeffer, 1912), described by Hoyle (1904); but there are no carpal pads and the manus is much more slender. The arrangement of the arm hooks and suckers and of the "Schutzsaüme" (which are usually damaged) is very much the same, though slight differences occur in the number of hooks. The arrangement of the ocular light organs exactly resembles that figured for *giardi*.

The shape of the body is distinctly more slender than that shown in Hoyle's figure, though the latter is actually of a larger specimen, and is more like that seen in Chun's figures (Pl. XII, figs. 1-2) which are more of a size with ours. The shape of the fins, on the other hand, is very like that seen in Hoyle's figure and unlike that in Chun's.

It is very remarkable that these specimens should show such a definite difference in the form of the manus from Hoyle's examples from the same locality. It is a pity that none of my specimens are males.

Genus and species uncertain.

One specimen from Stn. 51; S. of Hood Id., Galápagos; T-3 (No. 97); 274-0 fms.

The mangled specimen has hooks on the thin upper arm-pairs and the tentacles. There are no light organs on the eyes but there are traces of very small organs on the ventral surface of the head and mantle. The surface has, however, been scraped fairly clean and few of these organs are left. As their distribution is the chief diagnostic feature, the status of this form cannot be discussed.

FAMILY OCTOPODOTEUTHIDAE.

Genus and species uncertain.

One specimen from Stn. 28; E.S.E. of Cocos Id.; T-1 (No. 141); surface.

This specimen is in fairly good condition. It has hooks on the three upper arms and none on the tentacles. The suckers on the latter are of dubious arrangement (?2-3 rows). The absence of hooks on the tentacles and the biserial (?) disposition of the suckers might induce one to place it in the Octopodoteuthidae. The fins are very small, about one-quarter of the mantle-length. The head is enormous. There is a row of light-organs round the top of the eye-ball. I could distinguish none on the body or head.

Octopodoteuthis Rüppel.

Pfeffer (1912, p. 124) subdivided the Octopodoteuthidae into two groups, in a key translated (with some omissions) below.

- A. Arms (?always) with a spindle-like termination and long, small-based, "sich zum Teil deckenden" hooks which are arranged in two straight series mostly with suckers opposed ("zusammenhängenden"). Some normal suckers are found between the tip and the hooks, except in the ventral pair which is devoid of them and has rudiments of "Basalpolster." Fins terminal *Octopodoteuthis*
- B. Arms devoid of spindle-like end. "Die Haken sich nicht Deckend." Apparently no normal suckers.
1. Tentacle stumps persistent *Cuciototeuthis*
 2. Tentacles stumps not persistent *Octopodoteuthopsis*

Octopodoteuthopsis further has its hooks widely alternating and with broad bases. The oral surface shows a median groove or line. The fins are terminal, but not reaching the tip of the mantle.

The character of the two specimens before me make this classification very questionable. To begin with, though clearly conspecific, they vary a good deal *inter se*. One has a well-marked spindle-like termination of the arms; in the other it is almost imperceptible. In one there is a number of microscopic normal suckers between the hooks and the end of the arms. In the other I could not find them. These features do not present such a correlation of characters as would suggest that the two individuals are representatives of *Octopodoteuthis* and *Octopodoteuthopsis* respectively, as the one specimen with the end swelling (as in *Octopodoteuthis*) is devoid of the normal suckers (as in *Octopodoteuthopsis*).

Over and above these anomalies we must note a further incompatibility with Pfeffer's scheme. In one specimen the fins do not reach to the tip of the mantle (*Octopodoteuthopsis*), but the specimen has the end swelling of *Octopodoteuthis*. Similarly both seem to show the latter feature, yet in both the suck-

ers are arranged in a zig-zag and enclose a median groove (*Octopodoteuthopsis*). In short I believe Pfeffer's grouping breaks down and, though distinct groups may be found in this family, they are not revealed by his key. I place these forms provisionally in *Octopodoteuthis*, though there are some marked differences that might justify the creation of a new genus for them.

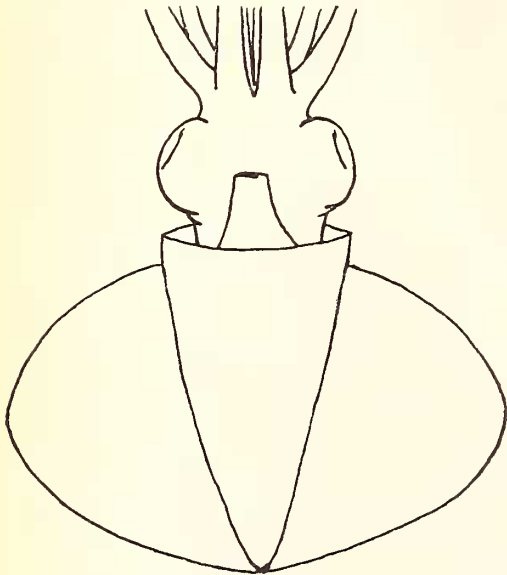
***Octopodoteuthis nielseni*, n. sp.**

(Text-figs. 2-4).

Two specimens from Station 74; Cocos Id.; T-69 and T-70; 400-0 and 500-0 fms. respectively. (Nos. 33 and 34).

- Dorsal length of mantle 26 (?+) mm.
- Maximum width of mantle 12+mm.
- Maximum length of fins 22 mm.
- Total width of fins 34 mm.
- Length of head (mantle edge to base of dorsal arms) 9 mm.
- Width of head 11 mm.
- Length of third left arms 36+mm.

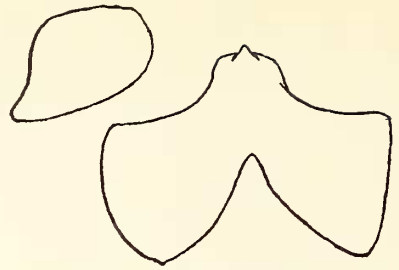
O. sicula has been many times described and figured. I shall at a later date give a full analysis of its variation, but confine myself now to pointing out the chief points of difference of *O. nielseni* from the eastern form.



TEXT-FIG. 2. *Octopodoteuthis nielseni* n. sp.; outline of body.

In *O. nielseni* the suckers and hooks are arranged in a zig-zag about a median furrow. So much damage has been done to the arms that it is not easy to say how many hooks there were. On one arm there are at least 20 pairs.

The hooks are, as in *sicula*, sheathed in fleshy casings and are upright and columnar. The fins are 84% of the body-length and their total span is 130% of the mantle-length



TEXT-FIG. 3. *Octopodoteuthis nielseni* n. sp.; funnel organ.

(both figures are the same as in *sicula*). The cephalic component of the adhesive-organ is not like that of *sicula* as shown in Pfeffer's fig. 9, pl. 19 (1912); there is a far wider and less distinctly channelled groove. Unlike those of *sicula* the arms are rounded and have neither "Schwimmsaume" nor "Schutzsaume." The latter are found in the oceanic form of *sicula* (Pfeffer) and both types occur in Sasaki's form. The funnel organ (Text-fig. 3) is not like that of *sicula* figured by Jatta (1896) though it is a little more like that shown by Sasaki (1929). The radula is quite unlike that of *sicula* (Jatta, 1896, pl. 13, fig. 8) in its tall rhachidian tooth, with an extraordinary small base and square admedian tooth. The radula is very unlike those of such enoploteuthids as I know. The admedian and first lateral are not unlike those of *Alluroteuthis* (Odhner, 1923, pl. I, fig. 18).

Remarks: This form is somewhat of a difficulty. The general shape and the form of the fins are not particularly different from those of *sicula* (e.g. as given by Pfeffer and Sasaki). The adhesive-organ, radula and the entire lack of membranes on the arms (which cannot be due to damage) are, however, features which preclude our ranking it with *sicula*. The adhesive-organ is of uncertain importance. Another point of diagnostic value is the great length of the third arms. The following table sets forth the relationships of the forms in question.



TEXT-FIG. 4. *Octopodoteuthis nielseni* n. sp.; radula.

sicula. Jatta. Longest arms 30 mm., mantle 25 mm.

Pfeffer. Longest arms equal mantle.

Sasaki. Longest arms slightly shorter than mantle.

nielsenii. Longest arms 36 mm., mantle 26 mm.

On the whole it seems best to regard the Galápagos form as a distinct species. At the same time it must be noted that *sicula* is rather variable and the status of the various forms called by this name is by no means clear.

This species is dedicated to my friend, E. Nielsen of Copenhagen.

?*Octopodoteuthis* sp.

A fragment from Stn. 1, PT-3 (No. 104), from the surface was labelled "*Octopodoteuthis*" by Mr. Pearson. It is now unrecognizable.

FAMILY ONYCHOTEUTHIDAE.

***Onykia* (*Teleoteuthis*, Auctt.) sp.**

4 specimens from Stn. 33; N.E. of Galápagos Is.; T-1, T-2 (Nos. 105, 144); surface; 5-6.5 mm.

1 specimen from Stn. 52; S. of Hood Id.; T-1 (No. 136); surface; 4.5 mm.

1 specimen from Stn. 59; S. of Cocos Id.; T-1 (No. 114); surface; 10 mm.

50 specimens from Stn. 74; S. of Cocos Id.; T-31-33, 35-36, 45-7, 50-65, 66 (Nos. 94, 101, 134, 67, 102, 140, 112, 81, 72, 129); surface; up to 13 mm.

13 specimens from Stn. 77; S. of Cocos Id.; T-1, T-2 (Nos. 124, 132); surface; up to 6 mm.

20 specimens from Stn. 78; N.E. of Galápagos Is.; T-1 (No. 126); surface; 4.5 mm.

2 specimens from Stn. 84; Galápagos Is.; T-1, 8, 9, or 10 (Nos. 151, 164); surface; up to 7 mm.

I am unable to assign this large assemblage of young forms, which range in size from just under 3 mm. up to about 13 mm. in mantle-length, to any known species. The Pacific species of this genus are very imperfectly known. If Pfeffer's figures (1912, pl. 1, figs. 12-13) of the tentacle of early stages of *O. caribaea* are at all representative of that species (which may possibly have a cosmopolitan distribution, but see Pfeffer), they differ markedly from the specimens under investigation in which at the stage represented in Pfeffer's figure 12 the tentacular suckers are far more irregularly arranged. At a stage more or less the same as Pfeffer's figure 13, the two marginal rows of suckers are enlarged and are not unlike those of *Thelidoteuthis* (Pfeffer, 1912, pl. 18, fig. 29). Indeed were it not for the absence of light-organs and other features in all the 91 specimens, I would be tempted to imagine that this might be referable to that genus. Unfortunately there are no signs of the dif-

ferentiation of the suckers into hooks except in one specimen 12 mm. long and in this the manus is so badly preserved that its precise arrangement cannot be made out.

***Onykia ?appellofi* (Pfeffer).**

A single (♀) specimen from Stn. 61; T-5 (No. 113); 600-0 fms.

The general shape of the head, body, manus and fins of this specimen agree very closely with *Onykia appellofi*. The manus is particularly like that of *appellofi* figured by Pfeffer (1912, pl. 3, fig. 9). The specimen measures 27 mm. in mantle-length.

***Onychoteuthis ?banksi* Leach.**

A very immature example 8 mm. long from Stn. 51, S. of Hood Id., T-2 (No. 156), 165-0 fms., may be referable to this species. It is very like the young specimens figured by Pfeffer.

SUBFAMILY LYCOTEUTHINAE.

Genus and species uncertain.

One specimen from Stn. 84, T-8, 9 or 10 (No. 163), in 500, 400-0 fms.

This is a small, well-preserved specimen measuring about 5 mm. in mantle-length. There are no hooks on any of the arms and none on the tentacles. The arm-suckers are in 2 rows, the tentacular ones in four rows, there being very little difference in size between the suckers. The adhesive apparatus is of the simple type found in the Architeuthidae, Enoploteuthidae and Onychoteuthidae. The fins are very small and terminal. Three light-organs occur on the ventral periphery of the eye-ball and on the under surface of the head and mantle. There are none inside the pallial cavity.

This is a very interesting specimen. It was originally labelled by Mr. Pearson as "Enoploteuthidae; genus undetermined." I think, however, that in young enoploteuthids of this size, the arm-suckers, and probably the tentacular suckers as well, are modified as hooks (cf. Pfeffer 1912, pp. 120 and 141). We ought, therefore, to regard it as an onychoteuthid (the Architeuthidae being ruled out by the occurrence of light-organs). In the Onychoteuthidae the hooks of the tentacles (when they occur) seem to be developed late, since in the specimen of *Teleoteuthis caribaea* over 5 mm. long figured by Pfeffer (1912, pl. 1, fig. 12), the hooks are not yet seen. This might be held to be an early stage of any onychoteuthid genus. The only group of this family, however, that have light-organs are the Lycoteuthinae. As (a) the equivalent stage of the other genera show a sign of size-differentiation in one of the marginal rows of tentacular suckers, which is lacking in this specimen, and as (b) the Lycoteuthinae have no hooks at all, I am inclined to regard this specimen as representing a new group of this subfamily differing from the typical forms in having ocular but no tentacular or intrapallial light-organs.

FAMILY HISTIOTEUTHIDAE.

Stigmatoteuthis Pfeffer.

In his key to genera of Histioteuthidae, Pfeffer distinguishes *Stigmatoteuthis* from *Calliteuthis* by its possession of denticular arm and tentacle-suckers and the lack of accessory chitinous structures on the manus. I am not altogether certain that this is a satisfactory distinction, as there are some marked deviations in the form of the manus in the species which by this definition fall into *Stigmatoteuthis*.

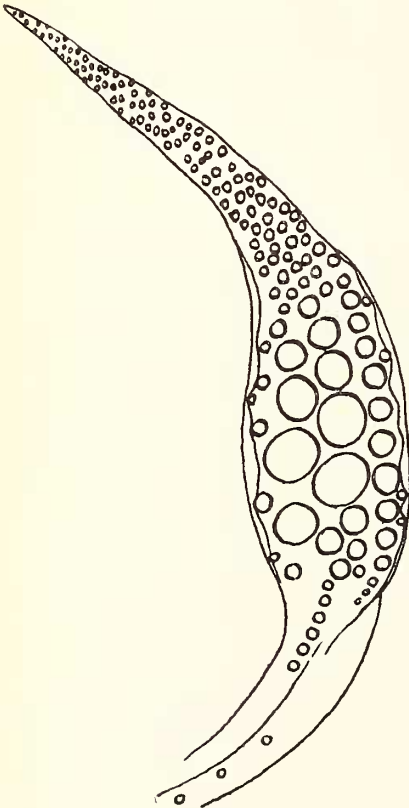
Stigmatoteuthis arcturi n. sp.

(Text-figs. 5-6).

One specimen (♀) from Stn. 7 (No. 18); (26° 54' N; 51° 15' W.); PT-1; 1,640 fms.-surface.

Dorsal Mantle, length:	32± mm.
“ , width:	16± mm.
Fins, length:	11± mm.
“ , width:	11± mm.
1st. arms, length:	ca. 64 mm.
2nd. “ “ :	ca. 64 mm.
3rd. “ “ :	ca. 66 mm.
4th. “ “ :	ca. 62 mm.

The head region has been badly damaged and the epidermis has been removed from all the arms save the ventral. The body is rela-



TEXT-FIG. 5. *Stigmatoteuthis arcturi* n. sp.; tentacular manus.

tively small and broadly conical. It differs in its greater width from *S. verrilli* (= *C. reversa* Verrill). The arms are subequal, but in their present condition it is not easy to specify their exact length.



TEXT-FIG. 6. *Stigmatoteuthis arcturi* n. sp.; cephalic light organ, ×13.

The chitinous rings of the majority of the arm-suckers are equipped with a number of low, broad and closely-set teeth. These are usually better marked on the distal periphery and on some they are virtually absent on the proximal part of the ring.

There is no trace of the excrescence on the proximal circumference noted by Pfeffer in *S. goodrichii*.

The fins are rather torn and their exact shape is uncertain. They seem to be sub-circular. The apical margin projects beyond the end of the body. The surface of the tentacular manus is roughly divisible into two areas, a proximal expanded part bearing the large suckers and a narrow and very much longer distal part bearing very minute suckers (Text-fig. 5). The general shape reminds one of that of *Calliteuthis meneghini* (Pfeffer, 1912, pl. 22, fig. 13), though the resemblance ceases there. There seem to be six rows of suckers in all, but two (the outer marginal of each side) are represented only by 2-3 very minute ones. The first two rhachial pairs are small and are followed by four very large pairs which decrease slowly outwards. After about the seventh rhachial pair the order becomes confused but the distal region seem to consist of 4 or 5 rows. The other margin is occupied by a single row of suckers which are very minute to begin with, and then increase up to the eighth, after which they decrease and become of a size with the distal ones. There is a carpal row of six suckers and knobs. There is no trace of any accessory chitinous pieces. The rim of the sucker-rings is beset, in the majority of the suckers, with a complete series of small distinct and acute teeth. The light-organs (Text-fig. 6) differ from those of *S. goodrichii* as figured by Pfeffer, (1912, pl. 22, fig. 9). The gladius has the lateral areas narrow and not wide as in *S. dofleini*.

This species differs clearly from those previously described, principally in the character of the manus. Differences from *S. goodrichii* and *verrilli* have already been noted. From *S. hoylei*, which it resembles in a gen-

eral way, it differs in the arrangement of the suckers of the manus. Also the teeth of the arm-suckers of that species are said to be sharp. From *S. japonica* it differs very distinctly, particularly in the tentacles. From *S. ocellata* it differs in that the suckers of the latter are "finely spinous" and from *S. dofleini* it differs in the tentacles (Sasaki, 1929, pl. XXII) and in having the lateral area of the gladius narrow and not wide.

Histiothauma n. gen.

Histioteuthid forms without any trace of a web and with very small fins. The peduncles of the suckers are enlarged to form large pyramidal structures. Arm-membranes of both kinds absent. The distribution of light-organs, as far as density is concerned, is midway between *Histioteuthis* and *Meleagroteuthis*. No light-organs on the dorsal surface of the mantle and fins. The tentacular suckers small and undifferentiated in size; no carpal system.

Type of the genus: *H. oceani* (see below).

For some time I was convinced that *Histiotauma* was a juvenile form of *Meleagroteuthis*. Not only is there a vague general likeness, but in some respects, notably in the disposition of the light-organs on the dorsal arms, the agreement is close. The geographical distribution of the forms also favours this view. On comparing the following list of differences it seems to me, however, that *Histiotauma* cannot be a young *Meleagroteuthis*. The difference between Pfeffer's specimen (26 mm. mantle-length) and Berry's (up to 59 mm.) are inconsiderable as compared with the differences between these two and the Galápagos specimen. Even if we disregard the condition of the suckers as problematical, so many points of difference still remain of an order not associated with growth-changes, that I have no option but to provide a new genus for the *Arcturus*'s specimen.

Mantle-length (dorsal): 7.2
Mantle-width: 8
Fins, length: 3.8 (±)
Fins, breadth: 2.6 (±)
Arms 1st: 16.0 (±2)
Arms 2nd: 16.0 (±2)
Arms 3rd: 16.0 (±2)
Arms 4th: 16.0 (±2)
Tentacles: ca. 42

The body is broadly conical and nearly as wide as long. The apex is rounded and blunt. The fins are very small relative to the size of the mantle and do not project beyond the apex and sides as in the other members of the family. They are very much crumpled and their exact shape is not certain but they seem to have been longer than wide.

The arms are subequal. They are devoid of swimming membranes and "Schutzsaüme." The suckers on all the arms are represented by their bases alone which are rather large (usually pyramidal) structures at the apex of which is sometimes seen the vestige of a thread-like stalk (?). On some of the arms a very minute adoral sucker persists. This is quite normal and its chitinous ring seems to be edentulous. Owing to their scarcity I have removed some of these for closer examination.

At first sight one would assume that the suckers had been lost by accident; but if they had been stripped by contact with some foreign body one would expect to find one or two persisting here and there over the arm generally as is often seen. One cannot speak for certain but it seems to me that this is no case of accidental loss. The "cartilaginous" tubercles found by Pfeffer on the dorsum of the three upper arm-pairs are present in this form. But I could find no median pallial row. Berry (1912, p. 308) could find neither and surmises that this may be a juvenile character.

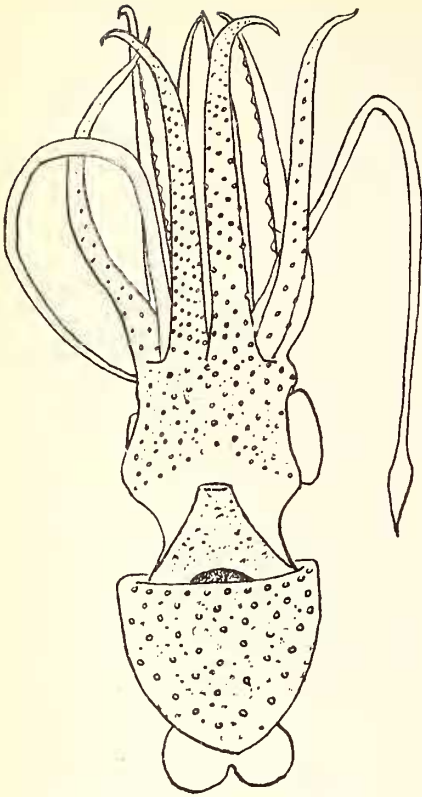
	<i>Meleagroteuthis</i>	<i>Histiothauma</i>
Light organs	Close, numerous. Dorsal and ventral.	Less numerous. Very few dorsal.
Web	Present between upper arms.	Absent.
Arm suckers	Normal.	? Absent.
Manus	Suckers clearly differentiated in size. Carpal suckers present.	Suckers more or less equal. No carpal suckers.
Arm membranes	Both types present.	Absent.
Fins	Over 1/2 length of mantle. Projecting beyond apex.	Well under that length. Not projecting beyond apex.
Light-organs	Complex.	Simple.

Histiothauma oceani n. sp.

(Text-fig. 7)

One example (♂) from Stn. 51; S.E. of the Galápagos; T-2, (No. 29); in 165-0 fms.

The tentacle-manus exhibits a number of minute suckers which show even less size-differentiation than *Meleagroteuthis*. They seem to be in six irregular rows. The rims exhibit a number of low knobs or plates which



TEXT-FIG. 7. *Histiothauma oceani* gen. et sp. nov.; ventral aspect, $\times 3$.

in some seem to be raised here and there into what would pass for teeth, though on the whole one would call them edentulous.

There is no trace of a web on any of the arms.

Light-organs: On the first three pairs of arms, there are two disposed irregular (dorsal and ventral) rows of these organs. Occupying the sagittal line on the 1st-3rd arms is a single series of subcutaneous white masses which may also be luminous. On the fourth pair there are five rows of organs, at least to begin with. The organs are rather openly distributed over the ventral surface of the mantle, below a line drawn diagonally from the edge of the mantle, opposite the eye, to a point on the ventral surface, just short of the apex. There are very few on the funnel or fins. The organs are simple and consist (macroscopically) of a simple globular body surmounted by a dark pigment mass.

The left eye, as in examples of other species in this family, is very much larger than the right. This is noted in *Meleagroteuthis hoylei* (Berry, 1912, p. 305; Pfeffer, 1912, p. 295), *Histiototeuthis bonelliiana* (Robson, 1924, p. 608) and in *Hymenoteuthis macrope* (Berry, 1912, p. 273). This curious phenomenon has never had sufficient attention paid to it. It may be the prelude to a general change of symmetry.

On the two ventral arms the reduction of the suckers is carried to a further extreme. The pedicels are over the greater part of the arm so reduced as to be almost imperceptible. Whether this is to be interpreted as hectocotylozation I cannot say. Unfortunately the animal is very immature and it is not possible to determine the sex from the internal organs.

Genus and species uncertain.

One specimen (? sex) from Stn. 74; S. of Cocos Id.; T-2 (No. 68); in 620-0 fms.

This specimen is very much damaged and does not permit of exact study. It measures 11 mm. in mantle-length. It cannot be readily accommodated in any of the known genera. It has light-organs of the scattered type, the suckers are edentulous, the manus is devoid of accessory chitinous pieces and has about 7 rows of smallish suckers. This combination of characters seems to exclude it from the genera hitherto known. As it is so young and may not represent the adult condition I refrain from describing it as a new genus. As a matter of fact, according to the figure of a young *Calliteuthis* given by Chun (1910, pl. 19, figs. 1 & 2, as *Histiototeuthis*, determined as *Calliteuthis* by Pfeffer, 1912, p. 268) the manus in that genus of a specimen with mantle-length 10 mm. is undifferentiated. On the other hand the fins of this form are quite unlike those of *Calliteuthis*.

One specimen from Stn. 86; Galápagos Is.; (No. 20); in 600-0 fms.

The remarks made about the preceding form are applicable to this specimen. It has scarcely any web, non-denticulate suckers, the tentacles are devoid of accessory chitinous pieces and the light-organs are small and far more separated than in *Meleagroteuthis*. By the ordinary procedure it is placed in the group of *Calliteuthis* and *Stigmatoteuthis*. But its characters (toothless suckers, no accessory pieces on manus) cut across Pfeffer's classification. It measures 18 mm. in dorsal mantle-length and may be a young form of either of these genera.

FAMILY OMMATOSTREPHIDAE.

Genus and species uncertain.

Two specimens (? sex) from Stn. 74; S. of Cocos Id.; T-7 (Nos. 82 and 73); ? Depth.

These are small specimens measuring 15 mm. in mantle-head length. Their position is rather enigmatic. The foveola is undifferentiated, which immediately ranks them with *Illex* and *Todaropsis* and yet the tentacular manus being clearly undeveloped (it consists of a few small suckers), it is impossible to say if they should go into *Illex* or into *Todaropsis*. Mr. Pearson originally diagnosed them as "*Symplectoteuthis*." Actually I found a very loose strand of tissue connecting the two parts of the adhesive-organ on one side of our specimen but it was really impossible to say if this was adventitious or not. The entirely undifferentiated foveola puts this suggestion out of court at once. In shape,

size of fins, etc., it is not at all unlike the young *Illex* figured by Pfeffer (1912, pl. 29, figs. 3-4). The adhesive-organ also is more like that of *Illex* than it is to *Todaropsis*; but the longitudinal cleft of the cephalic component is not nearly so open as in that genus. The denticulation of the suckers is very obscure.

SUBFAMILY STHENOTEUTHINAE.

Sthenoteuthis pteropus Steenstrup.

Seven specimens (6♀, 1♂) from Stn. 74, D. 1; (No. 803).

These specimens have typical tentacular manus, siphonal foveola and "adhesive-organs." The largest has a dorsal mantle-length of 110 mm., the smallest 49 mm.

Sthenoteuthis bartrami Lesueur.

One specimen (♀) from unknown station, (? CN 2).

A fairly typical form 144 mm. in dorsal mantle-length with 6-7 suckers on the proximal side of the first modified sucker of the manus. The cephalic element of the locking-apparatus is somewhat different in detail from that figured by Pfeffer (1912, pl. 35, figs. 8-9).

[?] *Sthenoteuthis* sp. (*Rhynchoteuthis* stage). (Text-figs. 8-10).

4 specimens from Stn. 40; off Albemarle Id., Galápagos; T-1 (Nos. 120 and 137); from surface.

1 specimen from Stn. 50; S. of Hood Id.; T-2 (No. 147); 400-0 fms.

1 specimen from Stn. 52; S. of Hood Id.; T-1 (No. 135); surface.

1 specimen from Stn. 53; S. of Hood Id.; T-2 (No. 103); 800-0 fms.

8 specimens from Stn. 62; off Malpelo Id.; T-1 (No. 138); surface.

1 specimen from Stn. 65; N. E. of Cocos Id.; T-3 (No. 121); surface.

1 specimen from Stn. 68; N. of Cocos Id.; T-1 (No. 108); surface.

15 specimens from Stn. 74; S. of Cocos Id.; T-66 (No. 130); surface.

9 specimens from Stn. 74; S. of Cocos Id.; T-45 (No. 139); surface.

5 specimens from Stn. 74; S. of Cocos Id.; T-66 (No. 131); surface.

13 specimens from Stn. 77; S. of Cocos Id.; T-2 (No. 133); surface.

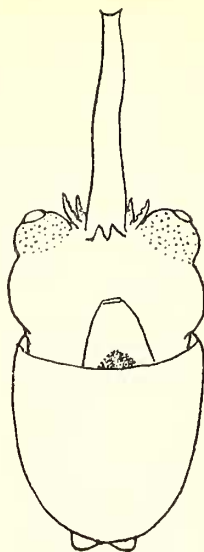
12 specimens from Stn. 77; S. of Cocos Id.; T-1 (No. 123); surface.

7 specimens from Stn. 78; N.E. of Galápagos Is.; T-1 (No. 128); surface.

13 specimens from Stn. 78; N.E. of Galápagos Is.; T-1 (No. 127); surface.

1 specimen from Stn. 84; Galápagos Is.; T-3 (No. 173); surface.

4 specimens from Stn. 84; Galápagos Is.; T-8, 9, or 10 (No. 161); 500-0 fms.



TEXT-FIG. 8. *Sthenoteuthis* (?), *Rhynchoteuthis* stage; larva with a mantle-length of 2.5 mm. from Stn. 53 (No. 103).

This interesting series of 102 individuals varying in size from 10 mm. (mantle-length) down to about 1.9 mm. seems to contain representatives of two species. The whole series was measured and the mantle-width and "spout" width was expressed as a percentage of length from the apex to the center of the eye. On the whole there is manifest a distinct correlation between small size and greater width of the mantle; in other words, younger specimens tend to be wider than older ones. They also tend to have a shorter "spout."



TEXT-FIG. 9. *Sthenoteuthis* sp. (?), *Rhynchoteuthis* stage; larva with a mantle length of 8.4 mm., from Stn. 74 (No. 130).



TEXT-FIG. 10. *Sthenoteuthis* (?), *Rhynchoteuthis* stage; larva with a mantle length of 3.5 mm. from Stn. 74 (No. 131).

Nevertheless the correlation is by no means absolute and two specimens (131/1 and 147/1) are far narrower than the average for their group-size and have a shorter "spout." These seem to me to be representatives of a different species. Chun (1910) noticed a similar dimorphism and Pfeffer (1912, p. 390) considered it evidence of the fact that two distinct species have a *Rhynchoteuthion*-stage. I suspect that the difference between No. 130/3 (width index 50) and No. 139/3 (index 34), of which one is but a millimetre longer than the other, is of systematic importance. Like Degner (1925, p. 42) I could find no clear indication of a differentiation into large- and small-eyed types (Chun, 1910). As far as I can see at present, it is by no means easy to assign any of the various *Rhynchoteuthion* stages to a particular species of the *Sthenoteuthidae*. On the whole specimens obtained by the *Arcturus* do not tend to resemble the early stages figured by Pfeffer (1912, pl. 37, figs. 8-10), though some later stages are like Pfeffer's pl. 37, figs. 2-3.

The most valuable information to be gleaned from these measurements relates to the "spout." Apparently it is developed at an earlier stage than any represented here, as in the smallest it is long and fully developed and the two moieties are nearly completely fused up. Chun (1912, p. 203) found it developed in a specimen 0.8 mm. long. Pfeffer (1912, p. 380) found a specimen of 3.2 mm. mantle-length still covered by an "embryonale Haut." Specimen from Stn. 84 (No. 173),

which measured under 2 mm. in mantle-length, was similarly covered in a membrane and was described by Mr. Pearson as an "egg." The spout is very well developed in this specimen. Its relative length gradually decreases until at about 9.0 mm. length it is not more than 10 or 12% of the body-length. At about this period the two elements which at the earliest stages are completely fused have gradually come apart and are found separated for $\frac{1}{2}$ - $\frac{3}{4}$ of their length. They eventually separate when the animal is 9-10 mm. long. It is quite evident that the fused moieties actually separate. A limited number (13) of these forms of sizes varying from 4.0 to 6.1 mm. in size do not show the spout at all. The tentacles which are very small are completely separated and seem to be mere stumps. It remains to be seen whether these are (1) members of a species distinct from those having the *Rhynchoteuthion* stage; (2) forms which have prematurely lost the funnel; or (3) forms in which it has not yet developed. The development, etc., of this organ suggests several interesting and important questions which are outside the scope of the present paper.

On the whole my results agree with those of Degner, as far as the formation of the spout is concerned. In the early stage it shows a complete fusion of the two moieties and at about 7 mm. long the latter are in contact towards the extremity only. I differ from Degner in finding that at about 7 mm. the area of fusion is in some individuals as much as half the length of the spout. Nor do I find the separation at the apex figured by Degner (1925, fig. 32).

Hyaloteuthis pelagica (Bosc).

One specimen (? ♀) from Station 54, off Hood Island, Galápagos (No. 55), taken at the surface from the ship.

This is a small and very slender specimen 25 mm. long by 5 mm. wide with fins 6 mm. long or nearly a quarter of the mantle-length. The ventral white patches have an arrangement much more like that shown by Férussac and d'Orbigny (1835-48, "Calmars," pl. 18, figs. 1 & 2; and "Ommastrèphes," pl. 1, figs. 17, 18) than that illustrated by Pfeffer. The structure of these patches does not agree with the descriptions already given, in two respects. (1) They are not raised above the surface as "petits tubercules blancs, à peine saillants" (Férussac and d'Orbigny, p. 348); (2) nor are they "feache punktförmigen Gruben, welche im ihrem Grunde je einen . . . Tuberkel tragen" (Pfeffer, 1912, p. 463). They are simply dense white and semi-lustrous patches lying evenly with the surface. A section through one shows no sign of special organization. I assume that, as this specimen is young (Férussac and d'Orbigny's specimen and that in the Hamburg Museum measured 55 mm. in mantle-length according to Pfeffer, 1912, p. 464), the light-organs may not be fully developed.

***Symplectoteuthis oualaniensis* (Lesson).**

One specimen (♀) from stomach of *Germolunga pelamis*, Stn. 74 (No. 5), S. of Cocos Id.

This specimen is very badly damaged and in particular the epidermis has been completely stripped off the ventral surface so that it is not possible to say if the ventral luminous streaks given by Sasaki (1929) as the only diagnostic difference between *S. oualaniensis* and *S. luminosa* are present or absent. Berry has placed the latter in a different genus, *Eucleoteuthis*.

The animal is a small one and measures only 70 mm. from the base of the dorsal arm to the apex of the body. It is remarkably slender as compared with the thicker specimens (e.g. that figured by Pfeffer), but agrees with *oualaniensis* in general shape and not with *luminosa*.

It further differs from *oualaniensis* in (1) the profile of the keel on the 3rd arms, which is lower and not triangular; (2) the shallower "Schutzsaüme" of that arm; and (3) the marked compression of the tentacular manus. I do not know how far all these characters might not be produced by maceration, etc.

Genus and species uncertain.

A very much mangled and fragmentary specimen identified by Mr. Wesley as *S. oualaniensis* does not appear to me to be referable to either of the species of that genus. The fins are well under 1/3 of the mantle-length.

FAMILY CHEIROTEUTHIDAE.***Chiroteuthis* (*Planctoteuthis* stage).**

(Text-fig. 11).

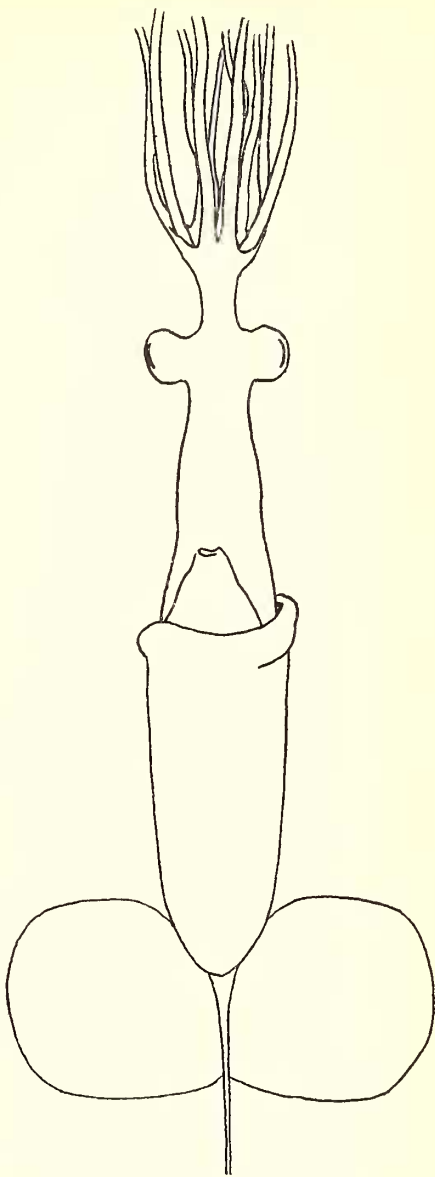
One specimen from Stn. 74; S. of Cocos Id.; T-70 (No. 40); in 500-0 fms.

This specimen, which is very much distorted and mangled, measured ca. 30 mm. from the upper edge of the fins to the eyes. The arms are in the order 4.3.2. (?3=2).1. The manus exhibits four equal rows of suckers which are not differentiated distally as in the "*Doratopsis*" stage. The cephalic component of the adhesive-organ has a basal projection, as in Chun's "*Doratopsis exophthalmica*" (1910, pl. XLVII, fig. 2). Like that species it also has a very slender "Hals" just above the eyes. But its fins are much larger and the body is wider. In the size of the fins it resembles the stage described by me as *Doratopsis* sp. A (1924). The form and length of the terminal spine is uncertain.

This seems to be a new juvenile form.

One specimen from Stn. 45, T-3 (No. 21), from 200-0 fms.

This specimen resembles the above very closely and is better preserved. The head and "neck" (above and below eyes) measure just about the same as the distance from the edge of the mantle to the posterior edge of the fins. This seems to have a complete "spine" 1½ times as long as the fins.



TEXT-FIG. 11. *Chiroteuthis* sp., (*Planctoteuthis* stage), ventral view of specimen from Stn. 74 (No. 40).

One specimen from Stn. 74, PT. 2 (No. 27), from 600-0 fms.

A larger specimen, very much crumpled. It measures 36 mm. in mantle-length. The fins are not quite so large.

Two specimens (fragments) from Stn. 68, PT.-1 (No. 172), from 600-0 fms.

Specimens very much mangled. Fins and mantle only, measuring 26 and 19 mm. in mantle-length.

One fragment from Stn. 74, PT.-1 (No. 201), from 600-0 fms.

Diagnosed by the characteristic fins. 35 mm. long.

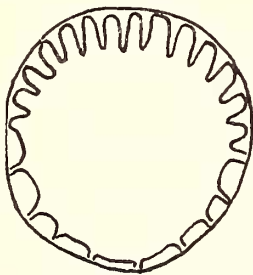
Mastigoteuthis sp.

(Text-figs. 12-13).

One specimen (? or two) (? sex) from Stn. 86; (No. 11); S.W. of Narborough Id., Galápagos Archipelago; (No. 17); surface-1,000 fms.

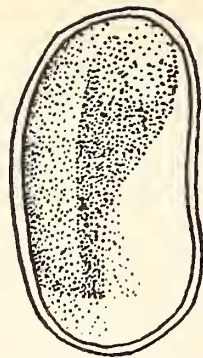
This specimen is in very bad condition. The skin has been entirely stripped off the muscles. It is represented by a head, body and fins all separate, and some fragments of tentacles. I am in fact very uncertain whether the body and fins belong to the same animal. For that reason I refrain from describing it as a new species, which I would most certainly be compelled to do if I were convinced that the fragments were referable to the same animal. The following are such data as I feel qualified to record.

Mantle-length:	65 mm. (?90).
Mantle-width:	24 mm.
Fins, length:	70 mm.
Fins, total width:	62 mm.
Arms R. 1 length:	70 mm.
“ 2 “ :	90 mm.?
“ 3 “ :	90 mm.?
“ 4 “ :	—
Tentacles:	280?+



TEXT-FIG. 12. *Mastigoteuthis* sp., sucker ring from the third arm, $\times 33$.

It is uncertain how long the mantle actually is, as the fins with what looks like the apical part of the gladius have been torn from it. The fins may have been 7/9 of the length of the mantle. They are only slightly longer than wide. The body is rather slender. The arms are probably in the order 4.3.2.1. as usual, but a very unusual feature is the great length of the upper arms which are longer than the mantle. The suckers of the third arm have their distal edge armed with about 14 longish teeth; proximally these become low, broad plates. The cephalic component of the adhesive-organ is moderately wide, its width being 53% of its length. Its rim is very narrow. This form differs from Hoyle's *M. dentata* (1904, p. 34) which was recorded from near the Galápagos in the size of its fins and arms, the dentition of the suckers of the latter and the shape of the adhesive-organ. Nor can I associate it with any other recorded species.



TEXT-FIG. 13. *Mastigoteuthis* sp., cephalic component of adhesive organ, $\times 5\frac{1}{2}$.

Mastigoteuthis sp.

A single tentacle just over 29 cms. long from Station 12; 27° 58'N. 46° 52'W.; (No. 166); "found on sounding-wire" (sounding of 2,840 fms).

This fragment is not like any previously described tentacle of *Mastigoteuthis*. The suckers are excessively minute and very numerous. They seem to be sessile or at least to have very short stalks. I could not distinguish any teeth on the rings.

One specimen (very much damaged) from Stn. 33, PT.-1 (No. 84); from 700-0 fms.

One specimen (very much damaged) from Stn. 50, T-2 (No. 145); from 400-0 fms.

One specimen (very much damaged) from Stn. 33, PT.-1 (No. 85).

Nothing very useful can be said regarding these damaged specimens.

FAMILY CRANCHIIDAE.

***Liocranchia reinhardi* Steenstrup.**

4 specimens from Stn. 38; off Tower Id., Galápagos; PT.-1 (No. 71); 300-0 fms.

1 specimen from Stn. 38; off Tower Id., Galápagos; Pt.-2 (No. 53); 500-0 fms.

1 specimen from Stn. 33; N. E. of Galápagos; Pt.-1 (No. 8); 700-0 fms.

1 specimen from Stn. 59; S. of Cocos Id.; PT.-1 (No. 52); 600-0 fms.

1 specimen from Stn. 74; S. of Cocos Id.; T-21 (No. 98); 600-0 fms. (shrivelled).

1 specimen from Stn. 74; S. of Cocos Id.; T-76 (No. 51); 500-0 fms.

1 specimen from Stn. 84; Galápagos Id.; PT.-1 (No. 61); 500-0 fms.

1 specimen from Stn. 84; Galápagos Id.; T-1 (No. 150); 300-0 fms.

1 specimen from Stn. 84; Galápagos Id.; T-8, 9 or 10 (No. 158); 500-0 fms.

1 specimen from Stn. 84; Galápagos Id.; T-5 (No. 47); surface.

7 specimens from Stn. 84; Galápagos Id.; PT.-1 (No. 7); 500-0 fms.

7 specimens from Stn. 84; Galápagos Id.; PT.-3, 4 (No. 54); 700-0 fms.

? specimens from Stn. 84; Galápagos Id.; T-14, 20 (No. 54); 500-0 fms.

1 specimen from Stn. 86; Galápagos Id.; T-11 (No. 48); 300-0 fms.

1 specimen from Stn. 86; Galápagos Id.; T-8 (No. 16); 500-0 fms.

1 specimen from Stn. 87; Galápagos Id.; PT.-1 (No. 46).

The following table gives the length \times width ratio and the length of the fins.

Coll. No.	Mantle-length	Mantle-width % length	Fins length % mantle-length
16	42	33	23
48	32	27	21
51	26	34	21
71a	26	28	12
71b	25	36	16
46	22	40	13
71c	19	36	13
71d	19	36	14
541	15	40	13
542	14	50	14
543	14	45	12
544	14.3	41	12
47	14	42	14
52	14	46	15
545	13.5	45	14
546	13.2	53	13
61	13	38	11
150	11.5	47	12
547	11	45	19
53	10.5	52	14
158	10+	50	18

From this it seems pretty clear that longer specimens tend to be narrower and to have longer fins. Nearly all the forms in the *Arcturus* collection are relatively narrow and only four attain or exceed an index of 50. The actual form of the body varies from a regularly narrow ovoid to a vase-like form with the greatest width situated anteriorly and slender apical region.

The fins: The apex of the body extends half way or rather less down the fins. I found no specimens like those figured by Pfeffer (1912, pl. 48, fig. 21) in which the apex scarcely overlaps with the fins. The fins are relatively very small and in no case exceed 23% of the mantle-length.

They tend to occur in two phases—one in which each fin has an outline representing the large part of the circumference of a circle and another in which they are rather wider than long.

Arms: In the largest specimen (No. 16) there are 16-17 pairs of regularly biserial suckers on the 3rd arms (cf. the very dif-

ferent arrangement in Sasaki's description). The tentacles differ from those usually encountered in that there is a very marked and abrupt difference in size (manifest at or about the 10th row) in the suckers, there being a small apical region of very small suckers and a larger proximal area having a number of very large ones.

"Ventral Bands:" Pfeffer (1912, p. 666) gives as a difference between this species and *globulus* Berry, that there is a double tubercle at the apex of the angle formed by the bands. I have found in these specimens that the tubercle is sometimes double, sometimes single and that sometimes there are two separate tubercles.

Remarks: *L. reinhardti* is manifestly a very variable species and I am not at all sure that all the forms which have been included in it are conspecific. Not only does the bodily shape and that of the fins vary enormously (though an age-factor is undoubtedly influential here), but also the arrangement of the suckers on the arms and tentacles, the relation between the fins and the body-apex, and other characters, etc., differ considerably in the described specimens.

The specimens here recorded seem to be a more or less homogeneous population; but until the variation of this species and of *valdiviae* is more thoroughly understood, the status of the various described forms is determined and the effects of age and sex evaluated, not much can be said.

Galiteuthis sp.

One specimen (?♀) from Stn. 86; off Narborough Is., Galápagos; T-2; 500-0 fms.

This very interesting form is badly damaged and in poor condition and I am unable, in the absence of several important features, to speak with certainty as to its status.

The form of the fins and the smooth arm-suckers ally it with *Galiteuthis*. Unfortunately the arms have been wholly stripped of their integument and one cannot find any trace of the support-membrane from which to see if the characteristic trabeculae are present. On the other hand the tentacles are absent, which Pfeffer (l.c.) makes a diagnostic feature of *Taonius*. It should be noted that Sasaki gives a description of a *Taonius* with complete tentacles. The outstanding feature of the present specimen, as in Joubin's specimen and one of Sasaki's, is the enormous length and remarkable slenderness of the body. Actually it measures 241 mm. from the centre of the eye to the apex and its width was probably about 22 mm. or under 10% of

	Length	Width nearly	Width: Length %	Fins % Length
<i>phyllura</i> (Berry, 1912)	230	35	nearly 15	49
<i>armata</i> (Chun, 1910)	121	20	16	42
(Sasaki, 1929)				
larger spec.	270	27	10	51
(Joubin, 1898)	350±	—	10	50

the length. The fins measure about 92 mm. from the tip of the gladius to the anterior insertion-point. They are thus nearer a third than a half of the mantle-length (actually 37%). These proportions may be compared with the other species.

The fins, as in Sasaki's figured specimen, but unlike those of Joubin and Chun, are continued right to the apex and there is no protruding "Schwanzfaden" as in the two latter. Differences in this respect as well as in the width of the body make it very likely that all the specimens recorded as *armata* are not actually referable to the same species.

Besides the features above indicated there are no others in a suitable condition for description.

***Taonidium pacificum* n. sp.**

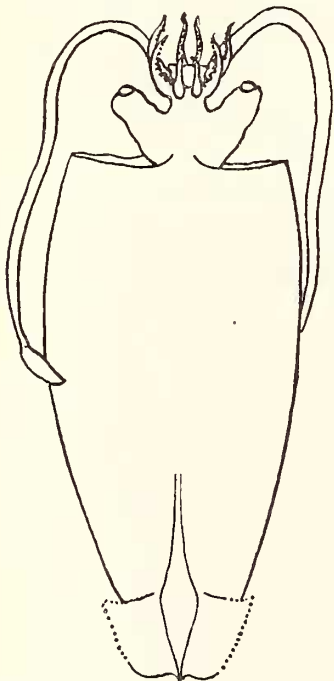
(Text-fig. 14).

One specimen from Stn. 66; N. of Cocos Id.; PT-1 (No. 49); 600-0 fms.

One specimen from Stn. 68; N. E. of Cocos Id.; PT-1 (No. 81); 600-0 fms.

Measurement (mm). (Larger specimen).

Dorsal mantle-length:	29±
Mantle, width:	14±
Head, length:	3
Fins, length:	4
Arms length, 1st:	2.2
2nd:	3.2
3rd:	4.4
4th:	4.0(?+)
Tentacles, length:	25.0



TEXT-FIG. 14. *Taonidium pacificum* n. sp.; dorsal view, circa $\times 2\frac{1}{2}$.

The body in both specimens is elongate and broadly conical. The fins in the larger specimen are about $\frac{1}{8}$ of the total length and together form a rather broad oval. They are distinctly longer than wide. In the smaller specimen they are much smaller and narrower and though it is likely that this small size may be due to damage, both fins are equal in width and there is no apparent damage.

The tentacles are about as long as the mantle (smaller specimen) or a little shorter than it (in the larger). The manus consists of four series of sub-equal suckers with smooth rings. There are about 10 rows of these. The tentacle stem bears two rows of minute suckers.

In the larger specimen the arms seem to be in the order $3 = 4.2.1$. The funnel-organ is more or less crescentic.

Remarks: According to Pfeffer's key this should be *P. chuni* but it differs from that obviously juvenile form (a) in the greater length of the arms and tentacles, (b) in the shape of the body and (c) in the size and shape of the fins.

***Helicocranchia beebei* n. sp.**

(Text-figs. 15-18).

1 specimen from Stn. 74; S. of Cocos Id.; Petersen Fish Trawl No. 1 (No. 144); 600 fms. to surface.

1 specimen from Stn. 86; off Galápagos; T-8 (No. 9); from 500-0 fms.

1 specimen from Stn. 28; S.E. of Cocos Id.; T-1 (No. 142); from surface.

1 specimen from Stn. 74; S. of Cocos Id.; OT-3 (No. 63); from 833-0 fms.

1 specimen from Stn. 74; S. of Cocos Id.; PT-1 (No. 39); from 600-0 fms.

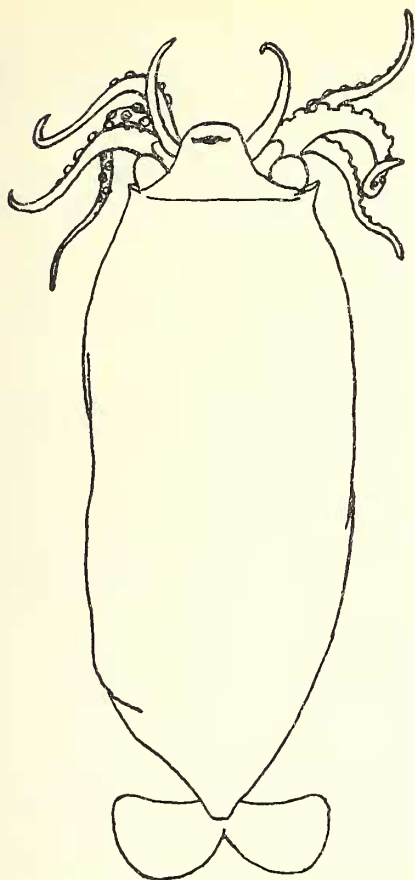
1 specimen from Stn. 74; S. of Cocos Id.; PT-3 (No. 58); from 620-0 fms.

Dimensions.

Dorsal length of mantle:	54	mm.
Width of mantle		
(round the curve):	26	mm.
Length of fins (maximum):	4.9	mm.
Width of fins (total):	13.0	mm.

	R.	L.
Length of 1st arm:	16	16
Length of 2nd arm:	16	17
Length of 3rd arm:	14	14
Length of 4th arm:	11	10

The mantle region is stouter than in *H. pfefferi*. The fins are peculiar and may constitute a ground for excluding this form from Massy's genus. She states in her generic definition (1904, p. 34) that the fins are attached to the end of the dorsal surface and are pedunculate. In our form they are certainly not pedunculate nor are they attached as in *H. pfefferi*. On the other hand there do not seem to be available any detailed drawings of the fin-insertion of *Teuthowenia*. On



TEXT-FIG. 15. *Helicocranchia beebei* n. sp.;
 $\times 1\frac{1}{2}$.

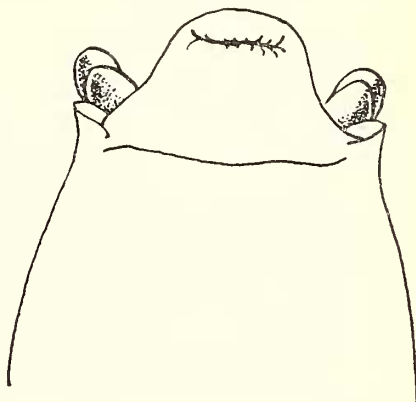
the whole in *H. beebei* the general plan of the insertion of the fins is not unlike that figured by Pfeffer (1908a, p. 105, fig. 120) for *T. megalops*. The shape of the fins and the angle at which they are set to the main axis are very characteristic.

The cephalic region, on the other hand, is very like that of *Helicocranchia*. The arms are in the order $1 = 2.3.4$, the longest arms are one-third the length of the body as in *Helicocranchia*, though the order is different. The funnel rises well above the eyes as in Massy's genus, but it is thicker and not so pointed as in the latter. The median part of the funnel-organ is of the same type as in *Helicocranchia*, but its three sections are all more angular and form a less symmetrical trefoil-pattern. The lateral portions are markedly different, as they are L-shaped and very remote from the median part. The suckers have been damaged. Each arm lacks a certain number, so that it is impossible to discuss their number and arrangement. The oral surface has apparently undergone some violent pressure and I find it a little hard to distinguish the real character of the surface.

For example most of the adoral suckers have an ovoid or squareish aperture and I am

unable to determine if this is the result of lesion or if it is natural.

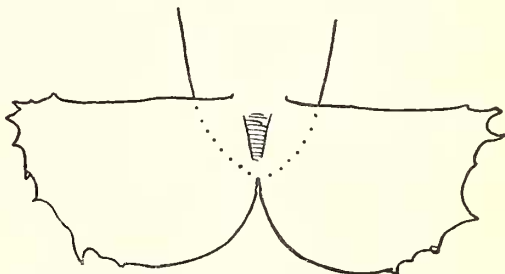
The tentacles are absent. They are represented by two exactly symmetrical stumps on each side. I believe that their absence is not due to accidental destruction, but resembles the similar abortion of the tentacles in *Octopodoteuthis* and *Taonius*. It would be necessary to obtain other specimens of the species before speaking with certainty on this matter.



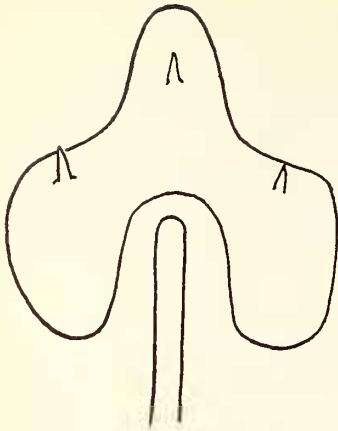
TEXT-FIG. 16. *Helicocranchia beebei* n. sp.;
 funnel, $\times 3$.

The eyes are large and placed on very short stalks, their longest axis being at right angles to that of the stalks. I do not find any obvious structure comparable to the ocular light-organ of *Helicocranchia* and *Teuthowenia*. I have compared the eye of my species with that of the type of *H. pfefferi* and find that the light-organ is very conspicuous and unmistakable in the latter.

This form is distinct from *H. pfefferi* in the fin-shape and attachment, eyes and in certain features of the funnel-organ, and from Berry's *Helicocranchia* sp. (1912) in the shape of its fins and arm-formula. It differs from *Teuthowenia* in the length of its arms and the position of the eyes relatively to the funnel. The apparent absence of ocular light-organs and possibly of tentacles may ultimately necessitate its elevation to sub-generic or even generic rank. The relationship of the genera and subgenera placed in



TEXT-FIG. 17. *Helicocranchia beebei* n. sp.;
 dorsal aspect of fins, $\times 5\%$.



TEXT-FIG. 18. *Helicocranchia beebei* n. sp.; funnel organ.

the group of *Teuthowenia* by Pfeffer requires further elucidation. I do not know why more stress was not placed by him on the marked divergences in the relationship between the height of the funnel and the level of the eyes.

Helicocranchia sp.

One specimen from Stn. 28; S.E. of Cocos Id.; T-1 (No. 142); from the surface.

Differs from the above in the lower funnel and shallow and more divergent fins. The specimen is very much distorted.

In addition there are two very much damaged and shrivelled specimens labelled "*Teuthowenia*" from Stns. 80 (No. 116) and 61 (No. 117).

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